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## ATTITUDE IN RELATION TO THE PSYCHO- PHYSICAL JUDGMENT<sup>1</sup>

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In psychophysical work the *doubtful* judgment has always given difficulty. At first it was a question how this judgment should be treated mathematically; later, when rules were established for dealing with *doubtful* cases or 'or-judgments' as intermediate categories, the question turned upon the nature of the *doubtful* judgment itself. The judgments 'greater,' 'equal,' and 'less' may be passed upon stimuli and sense-impressions; but what is there about stimuli or sense-impressions that leads them to be reported as *doubtful*? Rather

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<sup>1</sup> From the Psychological Laboratory of Cornell University.

it would seem to be the observer who is doubtful. In admitting that judgment, do we not allow a change in the reacting organism, whose constancy is a necessary presupposition of the psychophysical determination?

This question constitutes the principal problem of the present study. We first tried to examine the *doubtful* judgment directly, and to determine whether it necessarily or even usually represents a change in the attitude of the reacting organism. It soon became evident however that we could not attack the problem successfully in this way. We therefore sought by an instruction to compel the observer to maintain a constant attitude or disposition while giving judgments. We wished to see whether or not *doubtful* judgments would occur under this instruction; and if they occurred whether they gave evidence of a dispositional shift which violated the instruction. The evidence of such a shift was to be obtained both directly, from the reports of the observers, and indirectly, from change in their reaction-times of judgment. We hoped also to secure evidence of other attitudinal changes, if they occurred, and to trace their influence. We planned further to examine the status of all the categories used by the observers under the instruction. We specifically suggested the 'or-categories,' which are often used interchangeably with *doubt*, and the category 'no-difference,' which we thought might prove to be a truly impressional judgment that could fitly replace the judgment *doubtful*.<sup>2</sup> And since there is no *a priori* proof that an attitudinal change is not involved in the fundamental categories, 'greater,' 'equal,' and 'less,' we sought for empirical proof of their occurrence under a constancy of disposition.<sup>3</sup>

We have thus aimed to distinguish between intra-serial change, expressed in the law of the psychometric function, and extra-serial change due to gross shift of the observer's attitude. The organism is never constant, and its inconstancy is measured whenever a psychophysical correlation is made; when, *e. g.*, the correlation is a *limen*, the measure of intra-serial change is the measure of precision, *m. v.* or *h.* But

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<sup>2</sup> The category 'no-difference' did not, in fact, realize this logical expectation.

<sup>3</sup> We are obliged, for reasons of space, to omit historical references to discussions of the *doubtful* judgment (we have found but few that bear at all directly upon our problem), as well as the discussion of certain published results, suggested by the results of our own inquiry. Our general position is closely related to that of S. W. Fernberger (this JOURNAL, xxv, 1914, 538 ff.), though we have approached the problem of attitude from a different direction.

this inconstancy, the range of play within the neural machine, is different from the inconstancy which results when the machine is given a different set, and so becomes in reality another machine. Extra-serial changes lie outside of the series of categories prescribed by the experiment; they cannot be taken account of, or measured; they should therefore be, so far as possible, excluded.

### *The Instructions*

In the preliminary work definite categories were recommended. We wished our observers to take the judgment-scale as a whole, as a single complete series limited on the one side (say) by 'greater' and on the other by 'equal.' The instruction follows:

"You are to report on the relative intensity of two sounds; the second to be judged in terms of the first. The second, in this series, will always be greater or equal; and you will therefore be required to judge in categories whose limiting judgments are greater and equal. These categories are: greater, greater or no-difference, no-difference, no-difference or equal, equal. You will be asked after every judgment to give the introspective basis of your report. You are to judge with full attention."

This procedure, however, failed to secure the desired results. It soon became clear that no one of our observers was maintaining anything like a constant attitude toward the sounds. They were rather taking every judgment by itself, unrelated to the other types of judgment. We wanted them to realize a *series* of prescribed judgments, which would lie in one and the same straight line, and to judge with respect to a *gradation* that should remain true to the shades and nuances of a single mental attitude. The instructions were therefore changed as follows:

"You are to report on the relative *intensity* of two noises: the second to be judged in terms of the first. In this series, the second stimulus will always be greater than or equal to the first.

"You are to employ judgment categories of a *serial* nature; that is, you are to keep your receptive attitude constant throughout. Such categories might be: greater, greater or no-difference, no-difference, no-difference or equal, equal, . . . less.

"You are to judge with full attention. After judgment, you will make a report to the experimenter, noting especially (1) any gross shift of attitude, and its conditions; and (2) the conditions of change from one judgment category to another, such as may occur without change of general attitude."

The instructions were varied in a 'less'-series, by substituting the word 'less' for 'greater' throughout; while in the visual series the word 'extents' was used instead of sounds, and 'right' and 'left' instead of first and second.

The preliminary practice of the observers with the first instruction lasted, excluding the summer months, as follows: F, May to November, 1915; B<sub>o</sub>, May to October, 1915; B<sub>i</sub>, April to October, 1915; R, April to November, 1915; E, October 20 to 30, 1915.

Thus all the observers but E had, at the beginning of the final series, fairly extended practice in adjustment to the general experimental conditions, but as yet no specific adjustment to the new instructions. We have based the discussion of this paper entirely upon the series taken under the final instructions.

*Apparatus and Method*

We worked throughout with Fechner's sound-pendulum<sup>4</sup> for judging the intensity of sounds and with Wundt's frame<sup>5</sup> for judging visual extents.

A new attachment to the pendulum allowed us to work with close divisions on the scale. The attachment was a metal piece, about 5 cm. long, which fitted over the scale itself; in it were scale-divisions cut through the metal as grooves. The experimenter held the pendulum by a thin piece of hard wood which he placed in a groove; he released the ball by withdrawing this piece of wood.

The observer sat with his back to the apparatus. The time-interval between the two successive sounds was one second, controlled, together with the times of the warning signals, by a soundless metronome.

On the frame were two black lines, 2 mm. in breadth. The standard (left) was 33 mm. long. The variable (right) was drawn partly on the paper beneath the glass and partly on the inner surface of the glass. The two sections slid perfectly, the one beneath the other, so that qualitative differences along the length of the line were not distinguishable.

The observer sat a distance of about one meter in front of the frame, with his head in a head-rest. A cardboard shutter on a lever was used to expose the lines. The exposure time was one second. This time and the time of the warning signals were controlled by the soundless metronome.

The judgment-times of the observers were recorded upon a sinking kymograph in an adjoining room. The kymograph was started and stopped electrically from a switch under the experimenter's control. The time-line was written by a fork of 50 vs. The pendulum and the exposure-shutter of the frame were electrically connected to mark on the drum the termination of the period of stimulation; a lip-key in the observer's mouth gave the record of the time of judgment.

In both the auditory and the visual series we worked with very small units, one scale division on the pendulum and  $\frac{3}{8}$  mm. on the frame. Usually a series contained from 7 to 10 steps; thus about half of the stimulus-differences lay below the D. L. We used a modified method of limits, in which we passed always from either 'greater' or 'less' to objective equality, irrespective of the variation of O's categories. In about half of the series a report was taken after each observation; in the other series no reports were taken.

Under our instruction, the observer knew that the stimuli would be either greater (less, in the alternate case) or equal. We supposed that such a procedure with knowledge would eliminate expectation; but it did not. Whenever the observer seemed to suspect that the method was a method of limits, and consequently to anticipate that the series would begin with a difference and end with equality, we introduced an irregular series in which the stimulus pairs were given in haphazard order.

*The Observers*

Our observers were Dr. W. S. Foster (F), instructor in psychology, highly practised; Dr. E. G. Boring (Bo), instructor in psychology,

<sup>4</sup> G. T. Fechner, *Elemente der Psychophysik*, 1860, I, 176; E. B. Titchener, *Experimental Psychology*, II, i, 81; ii, 195.

<sup>5</sup> Z. Radoslawow-Hadji-Denkow, *Philos. Stud.* xv, 1899, 324; Titchener, *op. cit.*, II, ii, 257.

highly practised; Mr. H. G. Bishop (Bi), assistant in psychology, well practised; Mr. G. J. Rich (R), graduate student, majoring in psychology; and Miss G. English (E), graduate student, minoring in psychology. E was the least practised observer. F, Bi, and E worked with sound stimuli, Bo and R with visual stimuli.

#### STATISTICAL TREATMENT OF RESULTS

Table I gives an analysis of the entire experiment under the final instruction. Reaction-times were obtained for only about 75% of the total number of judgments; some series were taken without times, and sometimes the apparatus failed to work. The individual differences in reaction-time should be noted; the average time for F is more than twice as great as for Bi.

The data of Table II were computed in order to determine whether it would be necessary to treat separately the reaction-times of the series in which reports were taken and those of the series in which no reports were taken. The table shows the excess of the average time in the report-series over the average time in the no-report-series. A negative value means that the times were longer when no reports were taken. The differences shown are all very small, and there appears to be no general trend. The averages of all observers and all categories are, in the two cases, practically identical. We have, therefore, hereafter thrown together the times of the two types of series.

Table III shows the effect of practice upon the times and upon the occurrence of the different categories. The average reaction times (secs.) are computed for successive groups of 25 series each. These groups are indicated by the numbers I, II, III, and IV. In the cases where the number of series is not divisible by 25 (F, Bo, Bi, and E; see Table I for number of series in each case) the last group for each observer is an average for all the series remaining after the preceding 25 series had been taken. In general, F, Bo, and R show a practice-effect in the shortening of the times; Bi and E do not. The averages for all observers and all categories, shown at the bottom of the table, indicate that there is, in general, little change after the first 25 series.

Table IV shows the frequency of occurrence of the various categories expressed in numbers of cases.

The average times for the different observers and categories appear in Table V. In the last line of the table are given the averages of all the cases under each category (not averages of the averages of each observer), for the purpose of the com-

parison of the categories. These values do not, however, constitute a very satisfactory means of comparison, because

TABLE I  
ANALYSIS OF EXPERIMENT

Observer.....	F	Bo	Bi	R	E	All
Number of series taken.....	42	78	91	100	65	376
Number of judgments taken.....	377	718	799	868	586	3348
Number of judgments taken with times.....	269	580	579	719	382	2529
Average reaction time (seconds)...	1.50	0.83	0.72	1.14	1.10	1.00

TABLE II  
COMPARISON OF REACTION-TIMES FOR SERIES WITH AND WITHOUT REPORTS

Figures show in seconds the excess of reaction-times for series with reports over reaction-times for series without reports. No figures are included in this table when either reaction-time involved is an average of less than ten cases.

In this and all subsequent tables the following symbols are used to designate the different categories of judgment:

g, greater	g.nd, greater-or-no-difference
=, equal	nd=, no-difference-or-equal
l, less	nd.l, no-difference-or-less
nd, no-difference	g?, greater-doubtful
g=, greater-or-equal	l?, less-doubtful
=l, equal-or-less	=?, equal-doubtful
	?, doubtful (or "don't know")

Observer	g	g=	g.nd	nd	nd=	=	nd.l	=l	l
F.....	-.06					+.14			-.04
Bo.....	0					-.10			-.04
Bi.....	+.06	-.02				+.04		-.02	-.04
R.....	+.06		+.16	-.02	+.12	+.08	+.06		-.02
E.....	+.14	+.04				-.22			+.10

Average reaction-times of all observers and all categories:  
with reports = 1.006 secs.  
without reports = 1.000 secs.

TABLE III

## TEMPORAL COURSE OF THE REACTION-TIMES

Large type shows in seconds the average reaction-time for each category and each observer in successive periods which consist of 25 series each. These periods are indicated by I, II, III, and IV. The last period for every observer but R includes less than 25 series (see text).

Small type shows the number of cases upon which each reaction-time is based.

Obs.			g	g?	g=	g.nd	nd	nd=	=?	=	nd. l	=l	l?	l	?
F	I	Cases Time	60 1.62		1 1.68		4 3.20	1 3.00		41 2.06			4 1.66	52 1.14	6 2.72
	II	Cases Time	41 1.00			1 16.00				14 1.60				44 .92	
Bo	I	Cases Time	52 .94	4 .68					5 1.08	53 1.04			3 .76	25 .92	1 1.24
	II	Cases Time	73 .74						2 .48	87 .86				52 .72	1 .66
	III	Cases Time	57 .76							97 .82				44 .78	
	IV	Cases Time	6 .54							14 .74				4 .60	
Bi	I	Cases Time	21 .78		3 1.00	1 .60				20 .72		5 .82		42 .74	6 1.02
	II	Cases Time	38 .60		11 .66					60 .70		7 .70		61 .60	3 .78
	III	Cases Time	34 .62		12 .78					43 .74		14 1.30		69 .64	5 1.12
	IV	Cases Time	30 .70		8 .86					38 .92		6 .92		38 .58	2 .64
R	I	Cases Time	20 1.40			8 2.02	31 1.44	10 1.68		23 1.28	12 1.40			36 1.20	1 1.00
	II	Cases Time	27 .98	1 1.44		12 1.34	42 1.32	13 1.64		46 1.18	13 1.28			31 .98	
	III	Cases Time	39 1.00			18 1.14	47 1.26	8 1.20		24 1.00	8 1.04	2 .96		40 .88	
	IV	Cases Time	42 .88			17 1.12	64 1.06	8 1.18		20 1.00	16 1.04			41 .84	
E	I	Cases Time	59 1.02		14 1.20					24 1.06		8 1.36		20 1.10	
	II	Cases Time	50 .98		21 1.36					48 1.18		9 1.44	1 1.20	11 1.10	1 1.52
	III	Cases Time	64 1.28		62 1.24					54 1.08		75 1.50		11 1.00	

		Period	No. cases	Av. time
All observers and all categories...	{	I	676	1.23
		II	821	.94
		III	674	.87
		IV	354	.90



TABLE IV  
FREQUENCY OF CATEGORIES

Figures show the number of cases in which each category was used by each observer, and total distribution of the categories in numbers and per cents.

	g	g?	g=	g.nd	nd	nd=	=?	=	nd. l	=l	l?	l	?
F	145		2	2	5	1		82	1	1	5	126	7
Bo	207	4					12	317			7	169	2
Bi	171	1	43	2	1		2	223		49	1	284	22
R	179		2	66	219	45		132	53	2		169	1
E	207	1	74				1	203		33	2	61	2
Total	909	6	121	70	225	46	15	957	54	85	15	809	34
%	27.2	0.2	3.6	2.1	6.8	1.4	0.4	28.6	1.6	2.5	0.4	24.2	1.0

TABLE V  
AVERAGE REACTION-TIMES FOR THE DIFFERENT CATEGORIES  
OF JUDGMENT

Figures show average reaction-time for each category and each observer, its M.V., and the number of cases upon which it is based. The general average at the bottom of the table is an average of all cases under each category, irrespective of the observer who gave the category.

Obs.		g	g?	g=	g.nd	nd	nd=	=?	=	nd. l	=l	l?	l	?
F	Cases Time M. V.	101 1.38 .59		1 1.68 0	1 16.00 0	4 3.20 1.09	1 3.00 0		55 1.94 .62			4 1.66 .14	96 1.04 .40	6 2.72 .52
Bo	Cases Time M. V.	188 .80 .19	4 .68 .21					7 .90 .30	251 .88 .18			3 .76 .17	125 .78 .16	2 .94 .28
Bi	Cases Time M. V.	124 .66 .16		34 .78 .18	1 .60 0				161 .78 .19		33 .78 .15		210 .68 .18	16 .96 .35
R	Cases Time M. V.	128 1.02 .23			55 1.30 .33	184 1.26 .28	39 1.46 .30		113 1.12 .21	49 1.20 .25	2 .96 .18		148 .96 .22	1 1.00 0
E	Cases Time M. V.	156 1.00 .22	1 1.44 0	45 1.28 .13					113 1.12 .22		23 1.28 .19	1 1.20 0	42 .96 .08	1 1.52 0
All	Cases Time	697 .94	5 .84	80 1.08	57 1.44	188 1.30	40 1.50	7 .90	693 1.02	49 1.20	56 1.02	8 1.28	621 .84	26 1.40

TABLE VI

## ORDER OF CATEGORIES WITH RESPECT TO REACTION-TIMES

Table shows in seconds the average reaction-times, computed irrespective of the observers and corrected for their individual differences in time (see text); also the number of cases upon which each average is based.

Category of judgment	Number of cases	Average Reaction-time
l	621	.878
g?	5	.918
g	697	.922
l?	8	1.037
nd.l	49	1.049
=?	7	1.080
=	693	1.098
nd	188	1.123
g=	80	1.125
=l	56	1.143
nd=	40	1.297
g.nd	57	1.300
?	26	1.410

the different observers furnish relatively different numbers of cases in different categories. Since the observers exhibited great general differences in time of response (Table I), the averages depend to some extent upon the number of instances furnished by a given observer under a given category. The difficulty is overcome in Table VI, where corrected average reaction-times are shown for the categories. The correction was made by multiplying each time by the ratio of the average time of the observer in question to the average time of all observers for all categories (*viz.*, 1.00 sec.). *E. g.*, since F's av. time is 1.50 sec., his times were corrected by multiplying each by the ratio,  $\frac{1.00}{1.50}$  (see Table I for the times). Then these corrected times were averaged and arranged in the rank order of Table VI.

## THE QUALITATIVE STUDY OF THE CATEGORIES OF JUDGMENT

In the discussion which follows each quotation from the reports of the observers is prefaced (a) by the symbol designating the observer, (b) by a number which stands for the number of the series under the final instruction from which the quotation is taken, and usually (c) by a word (e. g., 'greater') which indicates the judgment. When the observer's remarks are general, (c) is sometimes omitted.

*General Adjustment of the Observers to the Conditions of the Experiment.*—The interpretation of the instructions gave, in general, some difficulty. Especially were the observers uncertain of the meaning of the term *attitude*. Bo and R complained that they were not necessarily aware of their attitudes, and that they could therefore not be expected always to report them.

Bo, 9. "I still do not know what a reportable attitude is. I feel sure what some such attitudes are: as doubt or expectation, but I can't tell whether some of these other factors which characterize the experience are attitudinal in the sense of the experiment or not."

Bo, 63. "I can't report expectation as a shift in attitude, because I can inhibit the conscious part of it and voluntarily take up a practically neutral set; but whenever I give 'equal' under such conditions I wonder if there wasn't some unconscious set or attitude which determined it."

Bo, 68. "I can't report this suspected expectation as a shift of attitude simply because it isn't generally conscious. I suspect it merely because I am often surprised when I get *equal* at the beginning and 'greater' at the end of a series."

R, 74. "There was a feeling of uncertainty, which has not been previously present. There was no change of attitude. I don't know what a change of attitude is, or that I ever experienced one in this whole experiment."

Bi showed particular difficulty in adapting himself to the experimental conditions. He was troubled throughout by the instructions and easily disturbed by chance distractions.

Bi, 18. "I can't make out the meaning of your *receptive attitude kept constant*. If *attitude* means my intention, the thing I try to do, then my receptive attitude is constant. If it means more than that, such a thing as my intention in addition to my attentive set, then it is not constant. I can't keep myself the same; distractions are always different. If it means that a graded series of external conditions is to be paralleled by a graded series of bodily, subjective attitudes, then I don't know whether my attitude is constant or not; I think it is not."

F and, to a less extent, E found difficulty in making the required abstraction to the attribute under consideration (intensity, since they judged the sounds). F, as compared with the other observers, tended toward a reflective and less immediate type of judgment, an attitude which might easily facili-

tate a focusing upon other attributes of the stimulus. Undoubtedly the mediate judgment occurs more readily when the presentation is successive (*i. e.* with sounds; F, Bi, and E) than when it is simultaneous (*i. e.* with the lines; Bo and R). In the former case the observer frequently tries to retain the first member either in imagery or in some other surrogate conscious process until the second member appears; or else the second member is consciously anticipated. Of the three observers who worked with successive presentation, the two giving the longer times (F, 1.50 sec. on the average; E, 1.10 sec.) had difficulty in making the abstraction to intensity. The average times for the two modes of presentation (averages of all cases, not of observers) are practically identical (1.008 and 1.001 sec.), because Bi gave immediate judgments with successive presentation. (Bi's av. time, 0.72 sec., was shortest of all.)

F, 11. "There *was* a difference between the two sounds. I hesitated; I wasn't sure whether the difference was one of intensity or not; made up my mind that there wasn't any difference and said *equal* without, therefore, great assurance. I was struck, not with the *equal* of them in intensity, but with their difference as sounds. Perhaps I should have said *no-difference*, but since I did decide that their difference wasn't a difference in intensity and since I was set to judge intensity, I naturally said *equal*."

F, 17. "I keep saying *intensity* to myself. In spite of these repeated instructions to myself, the sound as a whole very often catches my attention, so that the first impression is sometimes different, and I have afterward to make up my mind about the intensity."

Many similar passages occur in F's reports up to the end of the experiment.

E, 20. "They seem so different that I couldn't seem to compare them. I suppose I mean by that that their differences impressed me so that I couldn't catch the difference in intensity if there was any. They are qualitatively different in some way that I can't describe."  
... "Seemed as if I were reading something else into the experience besides intensity: I don't think it was tone, but I'm not sure that it wasn't vaguely that. The second seemed to go up."

*Doubtful Judgments.*—In 34 cases (1% of the total number) the observers reported *doubtful* or *don't know*. Two-thirds of these judgments were given by Bi (22 cases: Table IV), who experienced especial difficulty in adapting himself to the experimental conditions. The judgment was usually recognized as a failure of the instruction. The most frequent cause assigned was a 'lapse of attention.' It is obvious that a state of absolute doubt reflects a shift in the psychophysical conditions which violates the assumptions of the method; such judgments must either be ruled out or discarded, as, indeed, it is customary to do.

In some cases the observers pointed out that an absolute doubtfulness represents a change of attitude:

Bo, 31. "That is a miscarriage completely. Everything was normal up to the time that I took my lips off the key; then I discovered to my surprise that I had no judgment ready. I had to look back, was very much disturbed, couldn't make up my mind, and said *doubtful*. The course at first seemed normal, but I think that the failure of the judgment to come out automatically must have meant that my attitude had not been normal, that it had changed unconsciously."

Bi, 16. "I was wondering about the standard when the variable came; that is why I said *doubtful*. I didn't know much about the variable. This is a different receptive attitude, an active one. The attitude I am trying to keep constant is receptive passivity."

In 36 cases (again about 1%: Table IV) the observers gave other categories of judgments as doubtful, that is to say, they reported *greater doubtful*, *equal doubtful*, or *less doubtful*. In a very great many more cases their reports show that they were doubtful, although the judgment was not given as doubtful. It is not possible, however, to treat this second class of doubtfuls statistically, because no sharp line of division can be established. The judgments were given as 'doubtful,' 'probably doubtful,' 'possibly doubtful,' 'hesitant but probably not doubtful,' 'delayed and therefore doubtful,' 'delayed but not doubtful,' and so on. The relation of hesitancy to doubt we shall take up later.

Bo, 1, greater-doubtful. "Started to say *greater*, at least I know my vocal-motor apparatus started to say something, and I took it to be *greater*. Somehow that incipient utterance did not seem to follow from presentation of lines. I looked at left line, then right again; saw right as longer. Moment of hesitation; then I said *greater* (possibly my vocal-motor apparatus was going to say something anyhow) and added doubtful as a sort of compromise."

Bo, 2, less-doubtful. "First pair seen together as equal. Then right line got less, without getting more distinct; then it seemed to change to an extent between less and equal. I was all set by that time to say less, and as the right seemed to waver slightly between less and the intermediate point, I said *less-doubtful*."

Bo, 7, equal-doubtful. "Rapidly shifting consciousness. First the left line, then the right as equal. Then left, then right, with left as less. Then left, then right, with left at first as equal (a pair); then rapidly changing to less, and then to a doubtful length, *i. e.*, visual extent actually hazy and inclined to waver. . . . A compromise with the equal grew out of the final wavering." Equal-doubtful: "Not a fair judgment, since *equal-doubtful* means I don't know whether it is equal or greater or perhaps less, and therefore it is not a serial judgment, since it does not lie upon one side or the other of equal."

E, 51, less-I-think. "I wasn't perfectly sure of it. It simply put me into the doubtful attitude."

It is clear from the reports that the observers recognized

that these mixed doubtful judgments constituted a violation of the constant attitude required by the instructions.

Bo, 10, equal. "A little doubt after I started to say *equal*. Up to that point the course was normal" [*i. e.*, showed a constant attitude].

Bo, 60, equal. "Normal so far as my tentative judgment, but just as I started to say *equal* there was a catch in my throat and I was thrown into an attitude of doubt. Then the judgment *equal* came on out automatically."

Bi, 53, equal. "Or less. I don't quite know why I was doubtful, or why there were two probable values for the judgment. I think my attention slipped; I don't know just where this slip came."

We must note that there has as yet been no conclusive evidence of a serial position of any *doubtful* category. We can not say that doubt lies here or there in the series of impressions. That the mixed doubtfuls occupy intermediate positions between the positive categories might be argued at this juncture; we must, however, defer discussion of the point until we have considered the 'or-judgments.'

Bi, 63, equal. "Wanted to say *equal*, but that wasn't enough. It may be a *doubtful-equal*, but I don't think I know what that means. Experience largely visual. The variable left me with a gray spot in a visual field, with a dark hole besides. That hole seemed to be the *doubtful*, a blankness as at first." Bi has elsewhere tended to correlate the experience of 'blankness' with the attitude of doubt.

Bi, 85, less. "But I am doubtful. My attitude was pretty bad, particularly at the time the standard was given."

R, 11, less. "Along towards the end of the exposure, there occurred this same kinaesthetic reaction which carried the meaning *less*. But there was also a slight doubtfulness, which seemed to be an organic or kinaesthetic thing. It seemed to have inhibited or delayed the report. This doubtful feeling carries a sort of meaning or set not to report the judgment because it isn't right. This feeling disappeared quickly and then the report came." A positive case of the violation of constant psychophysical conditions by the attitude of doubt!

R, 22, less. "There was a baffled, puzzled feeling, which also seemed to be a kinaesthetic thing of the same nature as strain. It is the sort of thing that makes a doubtful judgment, although it wasn't prominent enough in this case to call the judgment a really doubtful one."

E, 5, less. "I didn't feel satisfied with this one. It might have been *equal*. I don't seem to know anything more about it. The judgment just comes. Sometimes I am satisfied with it and sometimes not."

E, 56, equal. "Both seemed *equal*, I think." Less: "I felt perfectly sure of judgment." Equal: "Didn't feel very certain about it." Equal: "Perfectly satisfactory and normal;" thus E implies that doubt is unsatisfactory and not normal. Equal: "Didn't feel as sure of that as of last." Many other passages in E's reports are similar to these.

The case against the *doubtful* judgments is substantiated by the quantitative results.

In the first place, the *doubtful* judgments are the least frequent of all the categories used (see Table IV). Beginning with the least frequent category, the rank order is as follows: greater-doubtful (0.2%), equal-doubtful (0.4%), less-doubtful (0.4%), doubtful (1.0%), and then on through the 'or-judgments' and the judgment 'no-difference' to less (24.2%), greater (27.2%), and equal (28.6%). It appears that the most infrequent categories might well be those against which the instruction to maintain a constant attitude had operated.

Furthermore, the *doubtful* judgments tend to drop out as practice progresses, as if with the firmer establishment of the constant attitude (see Table III). In the first 25 series 4.4% of the judgments with times are doubtful judgments; in the second 25 series, but 1.1%; in the third 25, 0.7%; and the last group of series, 0.6%.

The reaction-times furnish some evidence (see Table VI). The average time for the judgment *doubtful* (1.41 sec.) is longer than for any other category, and very much longer than the times for the *less* (0.88 sec.), the *greater* (0.92 sec.), and the *equal* (1.10 sec.). (It will be shown presently that the other and intermediate categories are closely related to the *doubtful* judgment.) These long reaction-times doubtless indicate that the judgment *doubtful* is of the reflective type; that it is given less immediately and as the result of a more complicated mechanism than are the positive judgments; and that it is, in so far as it breaks away from the simple correlating mechanism which the psychophysical procedure demands, inadmissible.

The mixed doubtful judgments, 'greater-doubtful,' 'less-doubtful,' and 'equal-doubtful,' do not appear to be given after longer times than their corresponding positive judgments (see Table VI). They are perhaps based upon too few cases (5, 8, and 7 respectively) to be representative. The values are, however, not unexpected. The positive judgments (greater, less, equal) include many reflective cases, many doubtful cases, and many cases in which doubt occurred immediately after the utterance of the judgment. The mixed doubtful cases include doubtful cases and some cases in which doubt appeared just as the utterance was being initiated and was added in the spoken judgment. The two classes of categories are, therefore, not so different as might at first appear. We have already noted that it was impossible to draw a sharp line of division, and to separate in the statistical treatment the really positive judgments from those for which positive categories were employed, but which were shown by the reports to have been more or less doubtful.

*Extra-Serial Attitudes Other Than Doubt.*—The observers tended to meet the difficult instruction with a complex response. This complexity was especially evident in the early series, before the judgments had become as nearly mechanised as they were later, and in the judgments of the more 'reflective' observers who did not under practice develop the immediate type of response. The following report of F is a case in point:

F, 6, greater. "Before the experiment I told myself to get into an attitude to keep constant, *i. e.* not to be too expectant that the second sound would be greater, but to set myself more or less as if this were an experiment in right and wrong cases. The first sound was heard clearly and remained in a kind of memory-after-image, or in a kind of steady intensity of strain which meant that I was holding on to it. Then the second sound was heard clearly as louder than the first, and immediately I said *greater*. Then relief. I was very certain of my judgment. I should say that the first sound is actively attended to. I expected it and held it after it had come. The second sound I hear more passively."

Here we have hints of many possible failures of a 'constant receptive attitude.' In the course of one judgment mention is made of expectation, relief, certainty, active attention, and passive reception. Do these states constitute attitudinal shifts which violate the instructions?

Fortunately for the experiment, the passage quoted may be regarded as an exception. All the observers, including F, tended under practice to acquire a greater constancy of attitude, which came about by way of a simplification of the mechanism of judgment. Bi, as we have already observed, alone failed to reach a sympathetic adjustment to the problem. Again and again he would be upset by distractions both within and without the experiment. The following report is typical of the more subtle form of disturbance to which he was subject:

Bi, 52, equal. "Conscious of time being longer between standard and variable. This is an observation of the duration of such strains as breathing strains, that gives me a different attitude than usual for my judgment."

Next to doubt, expectation constituted the most frequent mode of departure from what the observers styled the 'normal' attitude. Under expectation the observer expects something specific, some particular category of judgment or value of stimulus, and the thing expected naturally changes from observation to observation within a series: a change which is presupposed in the method of limits and, to a less extent, in the method of constant stimuli. Expectation becomes



therefore a particular enemy of the constant receptive attitude for the reason that it tends to be specific and to shift, not with the stimulus, but with the progress of the experiment.<sup>6</sup>

F, 8, equal. "My attitude that time was that I expected them to be near equal. The two came to me as equal; I went over them in imagery, still equal; so I said *equal*." Greater: "Still expected them to be equal. Second came as a little louder."

F, 10, less (long reaction time; given after five judgments of greater). "I couldn't help expecting *greater* because there had been so many. The first sound struck me as being absolutely loud; a little surprise that the second one wasn't so loud; I hesitated, then said *less*."

Bo, 11, less. "Same as before, except that I anticipated 'less' a little."

Bo, 35, greater. "I think that perhaps in my 'normal' attitude there is a little expectation of *greater*, and that *equal* partakes somewhat of the nature of a negative judgment, *i. e.* *equal* is *not-greater*. I should not say that the *equal* judgment is entirely defeated expectation, yet in one sense I think the *greater* judgment is the more expected. The thing is very subtle; it is hard to get at the expectation consciously; I should say it was generally unconscious. I just get hints of it once in a while, so that I can't be sure that it isn't there most of the time."

Bo, 45, equal. "I think I was a little disposed toward *equal* this time; I rather expected a series and that it was now about time to reach *equal*. I had misgivings about my judgment after I had made it."

Bi, 20, equal-or-greater. "After the signal I took the trouble to recall the previous pair. I think that made a difference in my judgment. It was harder for me to judge as I did because I had to get rid of this sort of expectation before I could judge the pair in its own right."

Bi, 23, equal. "Expected *equal* quite strongly. Standard was weak; that is why expectation was strong. My whole attitude seemed to shift when I found I was wrong on the standard."

Bi, 61, less. "I expected this less than it turned out to be. After I had said *less*, I felt quite positive that I might have said *equal* if I had been expecting *equal*."

Bi, 73, less-or-equal. "It may be I expected an *equal*, but I really found it pretty positively less. After that I returned to *equal* as I reported it. I can't tell whether I said *equal* through the persistence of expectation, or whether the stimuli actually warranted *equal*."

R, 75, greater. "I think there was a change in expectancy there, that is to say, you have been going along with serial judgments and I expected greater-or-no-difference in that region. I think I was set for such a judgment." "What I understand by attitude hasn't changed at all in the experiment, so far as I am aware. I have always put my judgments in the same serial categories, the attitude toward that has been constant. There have been, of course, changes in expectation, which I did not understand to be meant; so I didn't report them." R has still not thoroughly understood the instructions; his

<sup>6</sup> There can, of course, be constant expectations, which need not and can not be avoided. Such, for example, is the general expectation for 'equal or greater' or 'equal or less,' as the case may be, which was determined by the instruction for the two sorts of series.

report above indicates clearly enough that expectation meant a change of disposition toward the stimuli.

E, 16, equal-or-greater. "After the first sound a feeling that it was going to be all right now, that the next was going to be definitely less. When the second came it surprised me that it was as loud as it was." E gives many other reports of surprise which imply an expectancy. She does not explicitly characterize the attitude as a violation of the condition of constancy.

The general complaint of the observers, which we have pointed out above, namely, that attitudes may be unconscious and as such unreportable, is made specifically against expectation. The second quotation from Bo is relevant, as are also many from the reports of Bi:

Bi, 18, equal. "I intended to judge that one as something less than *equal*, though I didn't realize this intention until I had given the judgment. This amounts to an unconscious set suddenly becoming conscious, as if the previous judgment gave me an attitude for another like it. This attitude was unconscious, but when the stimuli seemed to demand the judgment *equal*, I seemed doubtful that it was *equal*, purely because I seemed to expect it to be like the preceding judgment. That is a shift of attitude, then. I don't know whether I have had expectations for other judgments or not, but I suppose I had. If I had they were unconscious."

Bi, 43, equal. "I expected that to be *greater*. It is again a case where the expectation does not become conscious until the variable is given."

Bi, 51, equal. "The feeling that the variable might be less even. Certainly I wasn't expecting *equal*. The *less* may have come from an unconsciously expected *greater*." And many other similar passages.

Bi alone of all the observers suggests that expectation may sometimes not vitiate the required constant attitude. We have had plenty of evidence from Bi as well as from other observers that it also frequently does, enough evidence, in fact, to make us insist upon its exclusion.

Bi, 23, equal-or-less. "I certainly expected *greater*, but not until after the standard had come. I was indifferent up to that time. No struggle at all, however, as to which judgment was right; the expectation wasn't insistent. It didn't seem to modify the feeling I had toward the judgment any more than if it were breathing."

Bi, 63, less. "I expected *greater*. I didn't seem at all surprised that the variable should come as less, and I didn't notice that expectation modified my judgment at all. The expected variable seemed irrelevant to the judgment."

These two cases are the only two explicit mentions of the irrelevancy of expectancy to the problem made by any observer.

The serial mode of presentation of the stimulus pairs (modified method of limits) favored the occurrence of expectation, in spite of the attempt to keep the observers in ignorance of the method by the occasional interjection of irregular orders

of presentation. All the observers but E explicitly mention a shifting expectation that grew out of a suspicion that a method of limits was being followed. For example:

Bo, 35, greater. "A *greater*, I think, was expected. At least at the beginning of a series, which I expect in a somewhat serial order, I am inclined to expect *greater*. I am not sure that I do not therefore shift my attitude as the series continues by expecting *equal* more and *greater* less. The thing is very subtle; it is hard to get at consciously;" *etc.*

Bi, 59, equal (the second judgment in a series which began with *greater*). "Or less. I think I'll say 'or less' because I expected *greater* as I do at the beginning of a series."

On the basis of such observations it would be in order to raise the whole question of the propriety of the method of limits, which puts a premium upon a shifting expectation. In the method of constant stimuli the rule that the observer should be told when each new series is begun is also open to question. If the subject is to be kept constantly disposed for the whole series under investigation, it is surely not permissible to allow dispositional shifts within that series.

It is next in order for us to enquire what other attitudinal changes besides doubt and expectation are likely to interfere with the maintenance of a constant disposition.

*Surprise* is mentioned frequently, but it seems in most cases to reduce to a form, or at least a concomitant, of expectation.

Bi, 31, greater-or-equal. "I wasn't conscious of any expectation, yet it does look as if I expected it to be *greater*. The same thing has happened a number of times: I feel surprise after the judgment. It seems as if this surprise comes as an unconscious expectation or valuation of the variable."

E, 16, equal-or-greater. "The first sound surprised me by being so soft; and then the second when it came surprised me too. I had the notion it would be very soft, and it surprised me by being so loud."

Surprise may, however, appear to leave the judgment unaffected.

Bo, 23, greater. "My attitude, besides being 'normal,' was one of surprise, although the surprise seems somehow irrelevant to the judgment."

A report of a positive attitude of *certainty* is exceptional. The 'normal' attitude seems to have been passive, neither doubtful nor certain, although it is possible logically to interpret the immediacy of the 'normal' judgment as a form of unconscious certainty. In several of the few cases in which certainty was reported as an attitudinal change, it was reduced directly to surprise and indirectly to expectation:

Bo, 12, greater. "There was the degree of expectation which a conscious reference to the instructions has. I knew that I was under

a different *Aufgabe* from the 'less-or-equal' instruction. I was shocked by the line, *i. e.*, shock = surprise at bigness of line = certainty of judgment. I should say that this certainty, due to surprise, was a definite shift of attitude."

There are no other types of attitudinal shift which are reported with sufficient frequency and positiveness to merit separate discussion. All the observers suspected dispositional variations at times, but their suspicions were not confirmed. There are a good many isolated statements like the following:

Bo, 12, greater. "For the most part a mechanical judgment, but just at the end of the period, before the judgment, I was definitely struck by the bigness of the line. I suppose that is an attitudinal shift." (This judgment was less immediate and more 'reflective' than Bo's 'normal' judgment; hence we must return later to the case when we discuss the immediate judgment as the normal judgment.)

*The 'Or-Judgments.'*—The judgments 'greater-or-equal,' 'equal-or-less,' 'greater-or-no-difference,' 'no-difference-or-equal,' and 'no-difference-or-less' were given in 11.2% of all cases (see Table IV for the distribution). Bo gave no such judgments and F but seven, so that for the description of the 'or-judgment' we must look to the other three observers. Of these Bi gave 94 and E 107, which were practically all either 'greater-or-equal' or 'equal-or-less.' R used the category 'no-difference,' and practically all of his 168 'or-judgments' were the combinations of 'greater,' 'equal,' or 'less' with 'no-difference.'

The descriptions of the 'or-judgments' are of three kinds. (1) The 'or-judgment' may reflect a mixed basis of judgment or a conflict between bases; (2) it may be the outcome of an attitude of doubt; or (3) it may appear to constitute a serial category in its own right. The first case shades imperceptibly into the second, since conflict is apt to beget doubt. Of the validity of the third case we shall have presently to enquire.

Both Bi and R report many cases in which an 'or-judgment' results from a twofold basis of judgment or from a vacillation between two conditions of judgment.

Bi, 27, equal-or-greater. "When variable came I had two spots of light, about same size, corresponding to intensity. The sizes were the same. I think in terms of throat kinaesthesia and I am inclined to believe that the difference came in there. It was somehow as if visually they were equal and kinaesthetically they were different."

Bi, 41, equal-or-greater. "Don't know why, except that there seemed to be two values for the variable in relation to the standard."

Bi, 42, equal-or-less. "Judgments of that sort have double value, the values of the variable compared with two different probable values of the standard. I don't know where the two values come

from. Such judgments are carried visually sometimes. The value of the variable is a point; the value of the standard is a line or an area and sometimes approaches the dumb-bell of cutaneous perception; the two ends are the two values of the standard."

Bi, 69, equal-or-greater. "Thick and short vertical visual imagery, which stood for both. I don't know why I changed to *greater*. A case of succession. Apparently I had a spot higher up which stood for the *greater*, while the line stood for both *equal*."

R, 2, no-difference-or-greater. "In that case there seemed to be a vacillation of judgment. At first the two seemed equal, although I do not know in what terms this equality came to consciousness. Then came the idea that the right was greater. The new judgment seemed to be principally conditioned by a kinaesthetic reaction to the stimulus which carried over in imagery from the end of the stimulation. I don't think there was any visual image of the lines to condition this change. The change came so late that I reported *no-difference*. As near as I can tell the doubtfulness of the judgment consisted first in the fluctuations of the judgment and secondly in the absence of a feeling of sureness."

The equivalence to doubt of a fluctuation of alternate bases of judgment is still further emphasized in the following instances:

R, 4, no-difference-or-equal. "That was a distinctly doubtful judgment. The two ideas alternated, *i. e.* the two meanings carried in kinaesthetic terms."

R, 14, greater-or-no-difference. After describing two meanings, kinaesthetically carried, for the two terms of the judgment, R continues: "I think the two meanings alternated, but I am not sure of it. Over the whole judgment-consciousness there was a general feeling of uncertainty."

E, 51, equal-or-greater. "Very, very doubtful. I seemed to hesitate, to go from one judgment to the other. I couldn't make up my mind."

Occasionally expectation conditions an 'or-judgment'; there is conflict between an actual impression and an anticipated impression:

Bi, 37, equal-or-less. "I think *equal* was what I expected and *less* was what the variable seemed really to call out. It is the same kind of unconscious expectation that I mentioned before. What I did was to turn from what presumably would have been a *less* without the expectation into the class of *equal-or-less*."

Bi, 59, equal-or-less. "Not very positive of expectation for *greater*. It may be that the expectation gave the 'or-judgment.' The standard was completely lost in the expected variable, so that I judged the variable against a standard transformed into the expected variable."

E, 34, less-or-equal. "The second one startled me, it seemed so small. When I started to speak, however, the word *equal* was in my mind, so that I said *less-or-equal*. The thing really struggling to be said was *less*, but there seemed some doubt about it and I said *equal*."

Equivocally determined judgments like the foregoing are frequent; they do not, however, form the greater part of the

'or-judgments.' The great majority of the 'or-judgments' are definitely doubtful judgments.

F, 8, equal-or-no-difference. "Quite open-minded. The two sounds came to me as about equal; I went over them in imagery trying to see if I could tell what the difference was if there was any difference. Still felt doubtful whether there was any difference, so I said *equal-or-no-difference*."

F, 27, greater-or-no-difference. "I wanted to say *greater-or-equal* instead of *greater-or-no-difference*. When the sound came I was immediately doubtful, as the second sound did not come as either different or not different; then it seemed to me a little greater; then it seemed equal; then I wanted to say *greater-or-equal*. Then I thought of my instructions [where 'no-difference' is suggested as a possible serial category] and it seemed to me as if *equal-or-greater* might not be in a serial line. Then it struck me that *greater-or-no-difference* satisfied the conditions pretty well, because, although the second sound did not come to me as positively not-different, neither did it come as positively different. I really think that *equal-or-greater* is my best judgment, for I think that it is serial." (An excellent example of the reflective type of judgment, so common with F!)

Bi, 18, less-or-equal. "I was awfully puzzled about that one. And while I was puzzled and waiting for some cue to come, everything looked intensely black. I don't think the blackness was important except that it was mixed with the hesitation."

Bi, 42, equal. "To say that that is *equal* is not saying enough. It is a *doubtful equal*, that is to say, what I call *equal-or-less*. Judgments of that sort have double values;" etc.

R, 8, less-or-no-difference. "The chief characteristic of that judgment was an organic feeling which meant uncertainty. I don't know why I knew the judgment was less."

R, 14, equal-or-no-difference: ". . . Also the feeling of uncertainty." Followed by *equal*: "This was different from the last one only in the absence of the feeling of uncertainty."

R, 26, less-or-no-difference. "The chief difference between this judgment and the last one [which was *less*] is the feeling of hesitancy which came in and prevented my reporting the feeling *less* which I had first. This hesitancy is a kinaesthetic thing and seems to be a sort of catching of my breath. The judgment practically amounts to a doubtful judgment of *less*, which, in order to express it in these terms [suggestion of the instruction?], makes me say *less-or-no-difference*."

R, 40, equal-or-no-difference. "That was a very doubtful judgment. The whole judgment-consciousness was colored by a feeling of indecision, hesitancy, or doubtfulness."

R, 52, equal-or-no-difference. "This was a doubtful judgment. It seems to differ from the last one [a *less*] in so far as the meaning of the judgment seems to be held up and not to come. This holding-up or hesitancy seems to constitute the doubt and is the only difference between it and the straight judgment *less*."

R, 77, less-or-no-difference. "The *no-difference* judgment really means doubt, which seems to be represented by the slowness of any judgment coming. I had the sensations from the two lines, before they meant either *equal* or *less*. As a result I gave the doubtful judgment. The judgment at first didn't mean anything; finally it did come to mean lessness a bit; the *no-difference* part is the *doubtful*."

And so on in almost all of the later instances. R's identification of the 'or-judgment' with the doubtful judgment is practically absolute.

E, 1, greater. "I don't feel perfectly sure of that judgment; I really ought to have said *greater-or-equal*. It seems as if it were hard to find the difference."

E, 10, equal-or-greater. "Doubtful feeling about that."

E, 14, greater-or-equal. "Doubtful. . . . A feeling of dissatisfaction in not being able to find a clear cut difference."

E, 16, equal-or-greater: After describing a dual basis of judgment, E concludes: "It seemed to me first *greater*, then not; but there was right away an indecision about it. I simply couldn't feel sure whether it was equal or greater." Equal-or-greater: ". . . . It was a doubtful judgment; I wasn't sure of it at all."

E, 28, equal-or-greater. "There was no sureness about that at all. I think my impulse was to say *greater*, and immediately on top of that came *equal*; *equal* popped out, but still I wasn't satisfied with it and so added *greater*."

E, 51, equal-or-greater. "Very, very doubtful. I seemed to hesitate, to go from one to the other: I couldn't make up my mind."

There are many similar passages in E's reports, all of them indicating that the 'or-judgment' is a doubtful judgment. E does not explicitly identify the two, but seems to take the identity for granted. By implication she regards her 'or-judgments' as failures.

There is now little room for doubt that the 'or-judgment' indicates essentially an infringement upon the constant receptive attitude. Instead of being the expression of a particular impression, as the psychophysical procedure demands, it is a logical compromise between two incompatible impressions. The very existence of two rival impressions in the focus of attention implies a shift of attitude, which is definitely recognized in those cases where the alternate impression is the result of expectation. Usually psychophysical constancy is still further disturbed by the shift to an attitude of doubt. 'Or-judgments' of this character are plainly not allowable in psychophysical work.

But is there not, one may ask, a definite, positive, intermediate, serial impression which is neither, let us say, 'equal' nor 'greater,' and which corresponds to a judgment of 'equal-or-greater?' Bo, who gives no 'or-judgments,' and F, who gives but few, do not find it. R explicitly denies it, and E implicitly. Bi alone hints of the existence of such a category, and that in only three places:

Bi, 49, less or equal: "That seemed normal enough. That 'or' wasn't due to expectation. A case of very near *equal*; as soon as I'd said *less*, *equal* just followed and seemed just as good. It is just like that. I don't know how the *equal* followed upon the *less*." Equal-or-greater: "This was just like the one before, except that the judgment was different. It comes spontaneously, as far as I can see."

Bi, 59, equal-or-greater. "That was a case of good conditions, but the difference was so small that I couldn't make it out."

These, however, are but three cases in three hundred and seventy-six. Elsewhere Bi agrees with the other observers. It therefore seems that, even if there is a definite serial impression corresponding to the 'or-judgment,' it is not indispensable; whereas the indiscriminating admission of the 'or-categories' in a psychophysical group is almost certain to destroy the serial nature of the group.

Finally we must add the statistical evidence. The 'or-judgments' do not tend to drop out under practice (Table III), but they are avoided under the instruction by the two most experienced observers, F and Bo. Consequently they constitute, after the doubtful judgments, the smallest categorical groups (Table IV). (The order, after the doubtful judgments, beginning with the least, is: 'no-difference-or-equal,' 'no-difference-or-less,' 'greater-or-no-difference,' 'equal-or-less,' 'greater-or-equal.') All five categories together form a group which is less than half the size of the group for 'less' or 'greater' or 'equal.' The infrequency of the 'or-judgment' argues that it may be dispensed with.

In general, the reaction-times for the 'or-judgments' are intermediate between the times for 'doubtful' and the times for the positive judgments, 'greater,' 'equal' and 'less.' Four of the five 'or-judgments' lie in the order of categories immediately below 'doubtful' (see Table VI). The average reaction-time of the five 'or-categories' is 1.17 sec.; of the three positive categories, .96 sec. It appears, then, as if the ambiguous and doubtful nature of the 'or-judgments' resulted in the lengthening of their reaction-times.

*The Judgment 'No-Difference.'*—The category 'no-difference' was employed almost exclusively by R (225 times). F used it five times, Bi once, Bo and E not at all.

As with the 'or-judgments,' so here we can find some slight evidence that 'no-difference' is a positive category.

R, 33, no-difference: "This was more like the *less* judgments. No particular doubtfulness on it; simply a different kinaesthesia that means a *no-difference* judgment." Later, *equal* following a *no-difference*: "The condition of change from the last judgment seems to be the presence of what I might describe as a positive feeling of equality; it is kinaesthetic and different from the general feel of the *no-difference* judgment. On the side of meaning it is quite different, for *equal* means that the two extents are actually the same, while *no-difference* simply means that they are so nearly the same that I can not tell which way the difference lies, if there is one."

R, 50, no-difference (following many series in which *no-difference* has been equated to *doubt*): "The judgment-category *no-difference* seems to be taking on a meaning of its own, apart from the doubtfulness which has been associated with it. The whole consciousness is simplifying. Instead of a *no-difference* judgment being indecision



between *greater* and *equal*, as it was in the preceding case, for instance, it is now as definite a judgment as *greater* or *equal* would be." But R never repeats this observation, and in Series 53 and repeatedly thereafter we find him again identifying *no-difference* with *doubtful*.

F, 2, greater. "I don't think I meant to say *greater* at all. . . . I really should have said *not different*. They were not different; not that there was no difference. When I say that there is definitely *no difference* I mean that there has been a true comparison, a true comparative attitude. *No-difference* seems positive. This was scarcely a real judgment, scarcely a comparison." This in Series 2; but F finds occasion to judge *no-difference* only five times in 377, and ceases entirely to use the category after Series 16.

Like F, Bi hints at a *no-difference* impression without using the category.

Bi, 70, equal. "Was distracted. Think I said *equal* because I couldn't find any difference,—a quite different experience from saying *equal* because they are equal."

Bi, 73, equal. "I said *equal* because I couldn't find any difference. I had a feeling that it shouldn't be *equal*, that expectation gave me the feeling to say *equal* because I couldn't find any difference."

We could make out a case against the 'no-difference' judgment on the basis of these positive instances alone. The category is used extensively by only one observer (R) among five; the other observers who use it (F, Bi) do so only in the early series; its identification as a positive category is exceptional, for no observer maintains this opinion for any length of time; R gives the most definite evidence (see above) that 'no-difference' is a positive category, but he also gives the most evidence (see below) that it usually is not; in the first two of R's three instances (see above) he admits that he was judging kinaesthetic surrogates and not the visual extents; in R's second instance above 'no-difference' appears to be a broad category lying neither to the one side nor to the other of 'equal,' and as such it is extra-serial and consequently taboo under the instructions; and finally R (second quotation) and Bi (both quotations) imply that 'no-difference' is really after all, not a positive, but a negative judgment, that it represents a failure to find either a positive difference or a positive equality, and thus, by implication, that it stands for a dispositional shift from a positive receptive attitude to a negative or defeated receptive attitude.

We have decided against the 'no-difference' category because of the insufficiency of its credentials. Now let us see what the direct evidence against it is, that is to say, how definitely it can be identified with doubt. For this category R is, as we have said, the important observer.

R, 2, no-difference. "The judgment showed no oscillation from one category to another as did the last one [an 'or-judgment'], but it was by no means sure."

R, 4, no-difference. "There was a feeling of doubt which made me say *no-difference* instead of *equal*."

R, 8, no-difference. "The first thing that I experienced toward the end of the exposure was a feeling of uncertainty. I was aware that I had no feeling of *greater* or *less*, and gave the report."

R, 11, no-difference. "The total consciousness there seems to be one of questioning or doubt, that is to say, I can find no difference between the two extents and this fits logically with the *no-difference* judgment."

R, 22, no-difference. "Here the prominent thing in the judgment is this feeling of 'puzzled' or 'baffled,' for the judgment *no-difference* as I gave it only amounts to a doubtful judgment. It seems due to a lack of prompt reaction which means a definite judgment such as *equal* or *less*."

R, 26, no-difference. "This was really a *doubtful equal* judgment. The general kinaesthetic set which means *equal* was present, but there was also a feeling of hesitancy."

R, 27, no-difference. "This was a typically *doubtful* judgment, *i. e.*, the predominant thing in consciousness was the hesitancy. The kinaesthesia which carried the meaning of a definite judgment seems to have dropped out. The feeling of hesitancy seems to be coming to mean a judgment of *no-difference*. *No-difference* is a report for the typically uncertain judgment or doubtful judgment. In the case of a *no-difference* with another judgment, as 'no-difference-or-less,' the *no-difference* comes to mean that I am not confident of the other judgment."

This kind of report is made again and again with too little variation to warrant frequent quotation. We have already noted that R departed from the interpretation of 'no-difference' as hesitation or doubt in Series 33 and 50. After each departure, however, he comes back to the old description. A few more samples, selected at wide intervals, will suffice.

R, 50, no-difference, given just before the 'no-difference' judgment quoted above in which R asserted the positive character of the 'no-difference' category, and just after a 'greater' judgment: "This differs from the preceding in the presence of a feeling of uneasiness, which means uncertainty in the judgment."

R, 53, no-difference. "This judgment is of the general character of doubt. There was kinaesthesia present which meant doubt. The preceding judgment [a *less*], unlike this one, seemed to come automatically." Equal, after a 'no-difference': "The general kinaesthetic feeling which carried a meaning of doubt or uncertainty disappeared."

R, 69, no-difference. "This is a typical uncertain judgment. A kinaesthetic feeling carried the meaning of uncertainty, or, as it is now coming to be, the meaning of *no-difference*. This kinaesthesia means *no-difference* directly, though I can see that it means doubtfulness also."

R, 77, no-difference. "Here even more typically doubtful judgment than the last [an 'or-judgment'], though the uncertainty was a kinaesthetic thing, a sort of tingling kinaesthesia in the chest which means uncertainty. For such a thing I use the category *no-difference*."

R, 91, no-difference. "Now this kinaesthesia, which carries the meaning of uncertainty, has become the most prominent thing in consciousness. It now seems to carry the whole meaning of the judgment, whereas before it just seemed to come in as something additional."

We can also quote Bi on the equivalence of 'no-difference' to doubt.

Bi, 15, greater-or-no-difference. "First the stimulus meant *greater*; then came a feeling of doubt and the thing meant *no-difference*. The whole experience was colored by doubt." No-difference: "The experience in the *no-difference* judgment is essentially an experience of doubt. Considered logically the stimuli are neither equal nor different. Kinaesthesia carried the meaning of uncertainty." We may guess that Bi recognized here that the judgment 'no-difference' violated the instructions, and that for this reason he never gave it again.

F was inclined in the early series, where he used the 'no-difference' category, to equate it to a particular kind of doubt.

F, 8, equal-or-no-difference. ". . . *No-difference* means no difference in intensity here. I wanted to say *doubtful*, and stopped myself from saying it because I wasn't entirely doubtful. *Doubtful* would have meant, 'I don't know anything about it.'"

F. 17. "I very often find trouble and sometimes have to give a *no-difference* judgment."

In the face of all this evidence it is impossible that we should admit the category of 'no-difference' in psychophysical procedure any more than we admit the doubtful categories. Four of the observers by their avoidance of 'no-difference' showed that the instruction tended to exclude the term, even in spite of the fact that it was explicitly suggested in the instruction. With R the suggestion of the use of the term in the instruction worked, although in working it did violence to the operation of the major purpose of the instruction (the maintenance of a constant, receptive attitude), as his reports abundantly show.

The reaction-times for the 'no-difference' judgments are on the average intermediate between the times for the 'or-judgments' and the times for the positive judgments and nearer the former, suggesting that 'no-difference' is a slightly more immediate kind of doubt than are the 'or-judgments.' (See Table VI. The av. times are: Positive judgments, 0.96 sec.; 'no-difference,' 1.12 sec.; 'or-judgments,' 1.17 sec.).

*The Judgments 'Greater,' 'Equal,' and 'Less.'*—We have disposed successively of the doubtful judgments, the 'or-judgments,' and the judgment 'no-difference' on the ground that they can not ordinarily be given under a constant serial psychophysical disposition. We are left with the categories 'greater,' 'equal,' and 'less,' and it now behooves us to enquire into the nature of these remaining forms of judgment. It is logically conceivable that 'greater' and 'equal,' for instance, are not serially related, that a change from the one

category to the other involves an extra-serial change in attitude, and that, as a consequence, psychophysical correlation becomes an impossibility. We are assured, however, by the observers that the contrary is the case; in broad general terms, at least, the judgments 'greater,' 'equal,' and 'less' are equivalents belonging to the same order, an order to which the doubtful judgment, in all the forms in which we have met it, does not belong.

F, 2, greater: "Just like my other judgments." Equal: "Just as usual. Judgment automatically says itself." That is to say, F reports no difference between 'greater' and 'equal.'

F, 6, greater, following an 'equal': "Just exactly like last experiment, only I said 'greater,' automatically. That it sounded greater is all I can say."

F, 40, greater: "No hesitation; both sounds tremendously clear; nothing else new." Equal: "Same." Equal: "Same." Less: "Nothing new; just a little surprise."

Bo, 9, equal, after a 'greater': "Mechanical judgment like the last."

Bo, 14, greater, after an 'equal': "I can't see that there was any change of attitude from the preceding judgment to this one of 'greater.' . . . If the change in the situation is a change in attitude, it is at least not the definite change which I understand by attitude, such as a change to surprise, expectation, certainty, and so forth."

Bo, 17, equal, after a 'greater': "I don't think I can find any difference of conditions of judgment there. The 'equal' came out just as mechanically as the previous 'greater's' have done. I wasn't even aware that I was giving a different judgment until after I had given it. As far as attitude or conscious conditions go, the last two trials seem to me practically identical." Less: "Some delay. . . . *Less* came as mechanically and immediately as the *greater's* and *equals* have. It did not seem to be dependent on the delay, although the delay is doubtless dependent on the lessness of the difference. I do not now see any difference between the necessary conditions of *greater*, *equal*, or *less*."

Bo, 20, less, after two 'equals': "I shouldn't say there was any gross shift of attitude from the last two times. The conditions for *less* appeared to lie absolutely in the visual impression. I see the lines and I say the judgment; that is about all it seems to be."

Bo, 22, equal. "There I had a change of judgment from *less* to *equal* that did not mean, I should say, a change of attitude. I was passive, attentively disposed, not doubtful at any time. I just made the first judgment and then changed it without the doubt or hesitation that I should call an attitude of uncertainty."

Bo, 26, equal. "Normal although I changed from *less* to *equal*. The judgment was normal in spite of the change because the change wasn't a change in my attitude but a change in the length of the lines—I saw the right hand line grow. I was not even disturbed by the change at the time, although afterward I was doubtful."

Bo, 31, equal, after a 'greater': ". . . I was surprised to find that I had changed the category so easily, practically without realizing it."

Bo, 39, equal, after seven 'greater's': "Normal. . . . I think this time my attitude was just the same when I gave *equal* as *greater*."

. . . . I should say the visual appearance of the extents was the condition of change."

Bo, 41, equal, after five 'lesses': "I can't see that there is any change in the conditions of judgment. This time was just like last time."

Bo, 52, equal, after four 'greater's': "Normal. Entirely like last judgment in spite of the change of category."

Bo, 55, equal, after six 'greater's': "Normal. I haven't the least idea what made me change my judgment. The whole thing runs off like the very smoothest habit."

The foregoing are but a few excerpts from a great number of long reports made by Bo, all with the same import. Bo continued to seek vainly for the conditions of change between these three categories, and could find in general only the visual impression, which he could not regard as attitudinal. He was continually troubled by his belief that an attitude is essentially a nervous affair and may normally be unconscious and unreportable.

Bi, 15, greater, after an 'equal': "The same kinaesthetic experience meant *greater*." Equal: "The equality judgment is in many ways like the *greater* judgment. It has none of the feeling of doubt or hesitancy; the general pattern of the experience is the same, save that the predominant kinaesthesia which carries the meaning is different. Instead of the chest kinaesthesia of *greater*, I have kinaesthesia in the upper chest or neck which means *equal* and is practically all there is to the equalness of the experience."

Bi, 40, less, after an 'equal': "This was the same type as the one I just had."

R, 2, greater, after an 'equal': "The only condition of change which I can find is the change in the relation between the two stimuli."

R, 25, less, after a 'less': "No change from last at all." Then equal: "The only condition I can find for the change is the difference in the stimulus and the sensation." Then less: "Just the same kind of difference between the two categories." Then less: "No change at all." Then greater: "The condition of change from one category to another was only a change in the sensation that gave rise to the judgment." Then equal: "Same conditions of change as reported last time."

R, 61, less, after an 'equal': "The only condition of change is a change in the stimulus. Both are so automatic that there is nothing conscious in them to change."

On several other occasions R made reports which are almost identical with this last one.

The category 'equal' appears to be more equivocal than the categories 'greater' and 'less.' On the one hand, 'equal' does constitute a positive category, comparable to 'greater' or 'less.'

F, 17, equal. "Second sound came as identical with the first." And thereafter F used the term *identical* to represent this special kind of *equal*.

R, 4, equal. "The feeling that the two lines were equal came quickly. It was a kinaesthetic image which definitely carried the meaning *equal*."

R, 58, equal. "The kinaesthetic feeling of *equal* came in."

R, 77, equal. "A typically different form of judgment [from 'no-

difference']. Instead of the kinaesthetic feeling of uncertainty, I know these things to be equal as if there were *equal* in them."

On the other hand, the 'equal' judgment is sometimes a doubtful judgment:

R, 40, equal. "The *equal* judgments seem to possess a little of a doubtful character. I am not as confident of them as I am of the *greater* or *less* judgments."

Other observers hint at the doubt. It appears that sometimes 'equal' is given when the judgment should have been 'greater-or-less,' a typical doubtful judgment of the 'or' type. It should be remembered further that the range of equality is limited in both directions, and that it is therefore impossible to have as striking cases of positive equality as it is of positive greatness or lessness. Between the equality which is doubt and positive equality there are degrees of hesitation which can not always be classed as doubt:

F, 18, equal. "There are degrees of definiteness of *equal*, I think. At least I am more certain of my *equal* judgments when there is identity than when there is not."

F, 28, equal. "They were nearer identical (not absolutely identical) than the last *equal*."

F, 36. "There are two kinds of *equal* judgments. There is identity where you automatically say *equal*; organic relief and an immediate judgment. Then there is the *equal* judgment which comes when you are struck by the difference of the two, but when you don't know whether they are different in intensity or in something else."

We should, therefore, keep explicitly in mind that the equivalence of the 'equal' judgment to the 'greater' and the 'less,' an equivalence which the reports attest, can probably be stated only of the positive judgment of 'equal.' There is a more or less doubtful judgment, which is sometimes masked by the term 'equal,' and which must be excluded with the other doubtful judgments.

The reaction-times for the three positive categories (Table VI; less = 0.88 sec., greater = 0.92 sec., equal = 1.10 sec.) are less than the times for any of the doubtful categories (except the mixed doubtfuls). The long time for 'equal' is probably due to the inclusion of a number of 'doubtful equals.' Hence the difference in time between the positive categories and the doubtful categories is in reality greater than here appears.

*Variations Within the Serial Attitude.*—We have dealt with the categories 'greater,' 'equal,' and 'less' in the gross, and we have found that they can be regarded as co-ordinate terms within a series, and that the psychophysical organism can apparently assume a constant disposition over against the

entire series without varying in attitude from term to term. By speaking thus generally we have not meant to imply that all judgments of a single category are identical, and indeed we have given warning that the term 'equal' may stand for very different judgments. Within the serial attitude there occur degrees of 'greater' and degrees of 'less,' possibly even degrees of 'equal.' We might dismiss this fact as of little importance were it not true that the various degrees of difference appear to be correlated with degrees of immediacy or delay, and delay is often described as 'hesitation,' and 'hesitation' sometimes means doubt. But doubt arises from a departure from the serial disposition, transgressing the instruction. Let us turn to the reports.

Of these degrees F has the most to say, but Bo, Bi, and E also admit their existence.

F, 11. "The judgments naturally seem to be either *greater*, *equal*, or *less*. It is rare that I get a *no-difference* judgment. But there is a difference among the *equal* judgments and among the *greater* and *less* judgments in the assurance or definiteness of the judgments."

F, 17. "I find considerable tendency to tell you 'how much' less very often. I think I could take a scale of 5 or 10 and say in terms of that scale how much less the sound was."

F, 18, greater: "Quite surprised. The second sound was very much greater." Greater: "Very much greater. The first was absolutely rather weak." Greater: "about 2 in a scale of 10." Greater: "Tendency to say 'not very much.'"

F, 25. "I can't see anything in the instructions to forbid me from giving these judgments on the basis of a scale of 10; so I have decided to try to get a serial set of judgments by estimating on a scale of 10. Thus, if I say 'less 10,' it means about as different as I ever get, i. e. the judgments are so-much *quantitatively* less. *Equal* would be 'less 0.' I don't seem to find doubtful judgments or 'or-judgments' except very rarely."

F, 26, equal: "Just a little hesitation and extra comparison. The two weren't quite identical."

F, 33, greater 8 (F is using his scale of degrees): "A quite definite organic reaction that goes with certainty and with judgments where the difference is greater than 4, say, on my scale. A different organic complex goes with hesitation, uncertainty, a not immediate judgment, such as when the difference is only 1 or 2. With the former goes the tendency to shout the judgment out; with the latter the tendency to put a question-mark in my voice and to speak slowly rather than quickly. When the judgment is 8 or 9 there is also surprise. When the judgments are around 1 or 2 I am pretty much always confused, perhaps hesitant."

F, 36. "I think you can make several distinctions of judgment: (a) Judgment surprisingly less, with a little shock to it. (b) Definite judgment, where one is automatic about giving it. There is little organic stir up; it is just normally *less*. (c) Judgment where there is strikingly little difference. The organics are different in these three cases. In the first case they seem to be surprise or shock. In the second they *mean* 'greater' or 'less.' In the third they are differ-

ent; there is strain in them, always strain with these smaller differences."

Bo, 44, greater. "Normal, delay. Of course there is a difference in the amount of difference between extents. I could easily make different categories of degree, say 'much greater,' 'slightly greater,' and 'barely greater,' for example; but I do not regard these categories as different in the way that is called for; they do not seem to be discrete. On the other hand, I am somewhat puzzled about them because they do seem to play a part. . . . I merely want to call attention to the fact that under the same attitude I may have very different experiences, which vary, on the side of impression, in degree of greaterness or lessness, and, on the side of subjective supplementation, in the amount of delay and the consequent patterning of consciousness, a patterning, which, in some cases, seems closely related to the attitude of doubt."

Bo, 76, equal. "Normal, but a little hesitation similar to doubt in which I wondered whether it was *equal* or *less*. Immediately after the trial I thought to myself that the difference between 'normal equal' and 'hesitant equal' is largely a difference in the appearance of the lines. When I became hesitant, I seemed to get the lines as 'less' and then as 'equal.' In other words, being doubtful in this way does not seem to be the sort of thing that doubt usually is."

Similar to F's degrees are Bo's reports of 'immediacy' and 'delay.' Bo fell into the habit of regularly reporting 'normal' judgments with phrases like the following: "Normal, immediate;" "Normal, delayed;" "Normal, slight delay;" "Normal, fairly immediate;" "Normal, perhaps a trifle hesitant." Thus immediacy and delay are always given as irrelevant to the normality of the judgment.

Bi, 70, greater: "Quite obviously *greater*, but not extremely obvious. I think *greater* was carried by a denser blackness." Greater: "Somewhat *greater*. Attention good. No definite imagery of any sort. I was pretty doubtful, because of the 'somewhat,' I guess."

E, 16, greater. "Very decidedly *greater*."

E, 26, less: "That seemed decidedly less. A sort of relief about it; hence easy to judge." Less: "The difference didn't seem as great. It was definitely less; still there was a different feeling about it from the last one."

E, 49, greater: "Just definitely *greater*." Greater: "No change, though the pair seemed nearer together. In both trials an attitude of assurance and satisfaction."

E gives a number of similar reports of degrees.

The evidence that there are more than three degrees within the series 'greater-equal-less' is complete. F uses a scale of 21 degrees (actually he employed but 16, however; from 'less-8' through 'equal' to 'greater-7'), but suggests that qualitatively there might be seven, three 'lesses,' an 'equal,' and three 'greateres.' The other observers are not so explicit.

The smaller degrees of 'greater' and 'less' are correlated with 'non-immediacy' or 'delay' or 'hesitation' or 'delay with alternation of judgments' or 'doubt.' It is not clear whether this state is properly to be called 'doubt' or not. It is certain that it is not the sort of doubt which we met in the *doubtful* judgments. That doubt was extra-serial and



meant a change of attitude. This takes its place within the series; its limens could be, if necessary, determined; it therefore comes within the instruction and is allowable in psychophysical method.

Bo is especially insistent upon the intra-serial nature of 'hesitation.' We quote a few of his reports:

Bo, 9, equal. "A hesitation before spoken judgment. I don't think 'hesitation' is quite the same thing as 'uncertainty,' although it is similar. 'Hesitation' is the being unable to give a judgment, whereas 'uncertainty' is the being unable to give a judgment because there is an alternation between tentative judgments."

Bo, 17, greater. "Passivity, then delay, then mechanical judgment. I think this delay isn't quite 'passivity,' because it involves searching for a way out. I am always restive under 'delay.'"

Bo, 34, equal. "Considerable delay, and something like an alternation of judgment during delay, hardly more than a strain in my chest. It was not doubt or hesitation; thus I can say my attitude was 'normal.'"

Bo, 35, equal. "I am under a tremendous logical suggestion to call any temporal hesitation or any alternation of judgments 'doubt;' but I am consciously trying to resist this suggestion because 'doubt' is an attitude and ought, therefore, in the sense in which I am using it, to feel 'doubty.'"

Bo, 41, equal. ". . . There was no 'doubt;' just hesitation and delay."

Bo, 45, equal. "That was a good normal judgment, although quite delayed." And so on.

Bi at one time equated 'slowness' of response to the 'doubt' of expectation, but later reversed his opinion:

Bi, 27. "What I call 'doubt' is slowness in accepting the judgment. It seems as if I might have had expectation and become conscious of it when the variable was given."

Bi, 38, less: "That was normal. I seemed to wait without any expectation at all. Ordinarily when I wait I seem to expect."

We may support the direct testimony of the observers as to the continuity of the successive degrees of the series 'greater-equal-less,' by an examination of F's reaction times for the various points on his judgment-scale (see next page).

Although the cases involved are very few, the curve of the times gives every evidence of being a continuous function. In fact, if it were to be regarded as discontinuous at any place, the breaks should be made between 'greater-1' and 'greater-2' and between 'less-1' and 'less-2,' for the smallest values of 'greater' and 'less' seem to group themselves more with 'equal' than with the other values of 'greater' and 'less.'

We have noted in our introductory discussion of the problem which the present experiment attacks that the most definitely recognized form of intra-serial variation is the constant

Category and its degree	Number of cases involved	Average reaction-time (seconds)
1-8	6	.74
1-7	10	.74
1-6	9	.90
1-5	5	.82
1-4	2	.68
1-3	7	1.08
1-2	3	1.00
1-1	2	2.00
=	55	1.94
g-1	2	1.90
g-2	6	1.06
g-3	7	1.06
g-4	5	.92
g-5	5	.96
g-6	10	.82
g-7	6	.88

change of disposition of the organism, over against the stimulus, which is taken account of in the psychometric function. In other words, the same stimulus under the same external conditions can not be expected always to give rise to the same impression. The reports of our observers are full of accounts of this kind of change. Many examples already quoted (*e. g.* Bo, 76, immediately above) show how the impression changed while the stimulus remained constant. At another time Bo reported:

Bo, 26, equal. "Normal, although I changed from 'less' to 'equal.' The change was a change in the length of the lines; I saw the right hand line grow."

Bo, 54, less. "Normal. The right hand line got very much less while I was making the judgment."

*The Normal Type of Judgment Under the Constant Attitude.*—All the observers tended, in the effort to maintain a constant receptive attitude, to make passive judgments. The passive judgment, moreover, tends to become immediate, although it is not necessarily immediate. The implication is that the way to maintain a constant attitude is to dispose oneself to make passive, immediate judgments. A few quotations, in view of the many which we have already given under other heads, will suffice to show the normal type of judgment.

F, 13, less. "I am open-minded for any judgment. The judgment just comes immediately. That is all."

F, 28, greater. "First impressed me as a little greater than those of the last series. Second came as immediately greater." These

reports occur in spite of the fact that F tended naturally to be reflective and to assure himself of his judgment (and sometimes of its degree) before he reported.

Bo, 55, equal, after a 'greater.' "Normal. I haven't the least idea what made me change my judgment. The whole thing runs off like the very smoothest habit."

Bo, 74, less. "Normal. What happened was that I saw the lines, and that, after a moment, I said *less* in the same smooth automatic manner."

Bi, 23, greater. "Perfectly indifferent, mildly attentive, no expectation at all. The standard was carried in an image until the variable came. Then just a step added to it, which meant *greater*."

Bi, 29, greater. "That was an automatic judgment. No attention to standard or variable. I just found myself speaking judgment in internal speech."

R, 18, less. "The kinaesthesia which carried the meaning of the judgment was very faint. Very little that was conscious in judging."

R, 24, equal. "A little more immediate and automatic than the last. Little conscious about it."

R, 87, equal. "That judgment was almost unconscious, practically automatic. The whole mechanism of kinaesthesia has dropped out." And yet this judgment represents a change of category from *no-difference* to *equal*.

E, 5, equal. "Judgment popped out instantly; it just came."

E, 8, equal, after a *greater*: "Just simply snapped right out the minute I heard the second sound."

E, 26, greater. "That just came popping right out; perfectly definite judgment; that was all there was to it."

The prevalence of the passive, immediate judgment marks it as the type. Furthermore some of the observers (most notably Bo) adopt it intentionally as a means of meeting the requirements of the instruction. F and Bi regard it as the normal attitude.

F, 36, less. "I said *less* before I realized that the series was 'equal-or-greater.' The judgment came automatically. . . . A definite judgment is where one is automatic about giving it. That is just normally *less*."

Bo, 11, less. "I am trying to be passive and mechanical as this attitude seems the most likely to remain constant."

Bo, 22, equal. "I am trying to keep my attitude constant by judging immediately, smoothly, and automatically. I think that an indication or change of judgment is a difference in the attitude."

Bo, 26, less: "That was normal, *i. e.* passive and automatic. I don't mean that there was a lack of attention when I say automatic, but that there was a smooth course." Less: "Normal and immediate. Immediate is the opposite of delayed. The procedure may be normal, but the meaning comes in slowly."

Bi, 37, equal. "This is my 'standard' attitude: indifferent, fully attentive."

Opposed to the immediate, passive, normal judgment is the 'reflective' judgment, which is by implication active and delayed. Most of the observers provide examples of this type, although F is the most prone to adopt it. (*Cf.* F's reaction

times, Table IV, which are much longer than those of his fellow observers.)

F, 2, greater. "The second sound was bigger, duller, thicker than the first, and something representing that bigness was in mind as soon as the second was over. After that I reviewed the experience in sensation and imagery; perhaps in kinaesthesia too, and then I felt kinaesthetically that the second was the more intense."

F, 27, greater-or-no-difference. "I wanted to say *greater-or-equal* instead. When the sound came I was immediately doubtful, as the second sound did not come either as different or not different. Then it seemed to me a little greater; then it seemed equal; then I wanted to say *greater-or-equal*. Then I thought of my instructions and it seemed to me as if *greater-or-equal* might not be in a serial series. Then it struck me that *greater-or-no-difference* satisfied the conditions pretty well, because, although the second sound did not come to me as positively 'not different,' neither did it come as positively 'different.'"

And so in many of F's reports; but they are too long to quote.

Bo, 58, equal. "I was starting to say *greater*; then hesitated and changed to *equal* because I knew *greater* was unlikely. This is not 'normal.'"

Bi, 59, equal-or-less. "I'll say *or-less* because I expected *greater*. The expectation hung on so that I judged the variable against my expected variable as if it were the standard. At least one of my two judgments was a comparison between the variable and the expected variable."

E, 16, greater. "At first it seemed as if I ought to say *greater-or-equal* or *equal-or-greater* perhaps, to get an *equal* into it in some way; but I immediately rejected that because the tendency to say *equal* was just a determination from the last experiment."

The reflective attitude is more complex than the passive; naturally, then, it gives more opportunity for variations. The doubtful attitudes, which we have found it necessary to exclude, are but forms of reflective attitudes. One dare not state dogmatically that a reflective attitude can not be maintained as constant. On the other hand, there is no evidence that it can. The safe rule in psychophysical work upon simple sensory judgments would seem to be to restrict the observer to a passive, immediate type of judgment, and to exclude all other forms by specific instruction, by the control of conditions, and, if need be, by the rejection of failures in the manner in which the failures of attention are ordinarily rejected.

The great enemy of the immediate, passive judgment is the stimulus error. The reflective judgments occur most readily when the observer is judging objective lines or objective sounds, is trying, in a sense, to be right. The impressions change, under the dispositional variations within the psychometric function, so that in a delayed judgment a single category can seldom represent the impression; hence the premium

placed upon judging stimuli rather than impressions. The immediate judgment simplifies the impression by cutting down the opportunity for temporal variation; the passive attitude creates a stable disposition. The two together tend to reduce the psychophysical correlation to its simplest terms and to render it meaningful as a scientific datum by keeping all of its conditions constant except the variant under investigation.

*The Term 'Attitude.'*—We may be accused of using the term 'attitude' in this paper in an indefinite sense. It is true that we did not define the term to our observers, nor have we defined it since. All the observers objected to it at first, complained that they did not know what was meant, or stated that since an attitude might be unconscious they could not be expected to report upon it. Our justification for the term lies, however, in the outcome of our work; at the end of the experiment we find the observers reporting constancy of attitude and change of attitude as a matter of course. They name and even partially describe attitudes. They still assert that attitudes are sometimes unconscious; and consequently they are still concerned lest certain attitudes, being unconscious, should be unreportable. There can be no doubt, however, that the word came to have a real meaning, and that the positive results of our present study reflect an intelligible use of the term.

We must still, however, postpone the definition of the word. Undoubtedly attitude is psychophysical. Obviously, also, it is sometimes but not always conscious. The maintenance of a constant attitude becomes at least partially feasible because there turn out to be three ways in which we can know something about attitude in general. In the first place, a new and intruding attitude may be conscious, and as such observed and reported by the observer. In the second place, a change of attitude may not be immediately conscious, but may make itself felt after the fact by some new and unusual conscious feature. For example, the observers sometimes suspected 'expectation' because they found they had given, automatically, a category which they could explain afterward only by supposing the influence of expectation. Thus we may learn of attitudes from the reported inferences of observers. Finally, the reaction-times furnish an objective clue. A wide departure from the normal reaction-time for a given variable stimulus is a strong presumption in favor of an attitudinal change, whether conscious or unconscious.

We must add that the recognition of the gross factor which we have referred to as attitude or disposition occurs in almost

any major piece of psychological work. We read in the literature of the effects of distraction, the need of avoiding distraction, the necessity of judging with maximal attention; we are told that this observer altered his criteria of judgment and that that observer used a secondary cue; we find the literature of the metric methods full of reference to expectation, habituation, and fatigue. All these discussions imply that an attempt is being made to keep the psychophysical machine constant or to take account of its inconstancy; but no one defines an attitude. And the analysis of the psychophysical disposition must wait for further investigation. Meanwhile we have demonstrated that it is possible to use the term in the gross and still to achieve results which may contribute toward the standardization of the conditions of the psychophysical experiment.

#### CONCLUSIONS

It is possible in psychophysical work for an observer to maintain a constant disposition or attitude over against a particular series of impressions.

Doubt and expectation and their derivatives usually violate this constant attitude. The 'doubtful judgments' of psychophysics, the 'or-judgments,' and the judgment 'no-difference,' all imply the introduction of a form of doubt which lies without the serial disposition, and must therefore be excluded from the ordinary psychophysical computations.

The judgments 'greater,' 'equal,' and 'less' may all occur under the same constant serial disposition. Various degrees of 'greater' and 'less' may also be given under the constant attitude.

The immediate and passive type of judgment is favorable to the maintenance of constancy of attitude. A reflective judgment, on the contrary, favors dispositional change.

If, then, our results are confirmed by other investigators, it will be advisable in future psychophysical work so to frame instructions and so to direct preliminary practice that constancy of attitude and immediacy of judgment become natural and normal to the observers. The end cannot be attained by prohibition of the 'doubtful' judgment or by the requirement that the observers guess at a difference in every case; for these instructions secure constancy of the expression of judgment at the cost of instability of attitude. The observers must rather be trained in such a way that the experimental situation, while it may prompt to the response 'delayed equal,' *e. g.*, shall not suggest the response 'doubtful.' If with some observers or under certain circumstances the *doubtful* judgments persist, they must be made the subject of special study on their own account, and not included in the data used for the regular computation.